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RISK ANALYSIS OF THE 155MM CANNON-LAUNCHED GUIDED PROJECTILE

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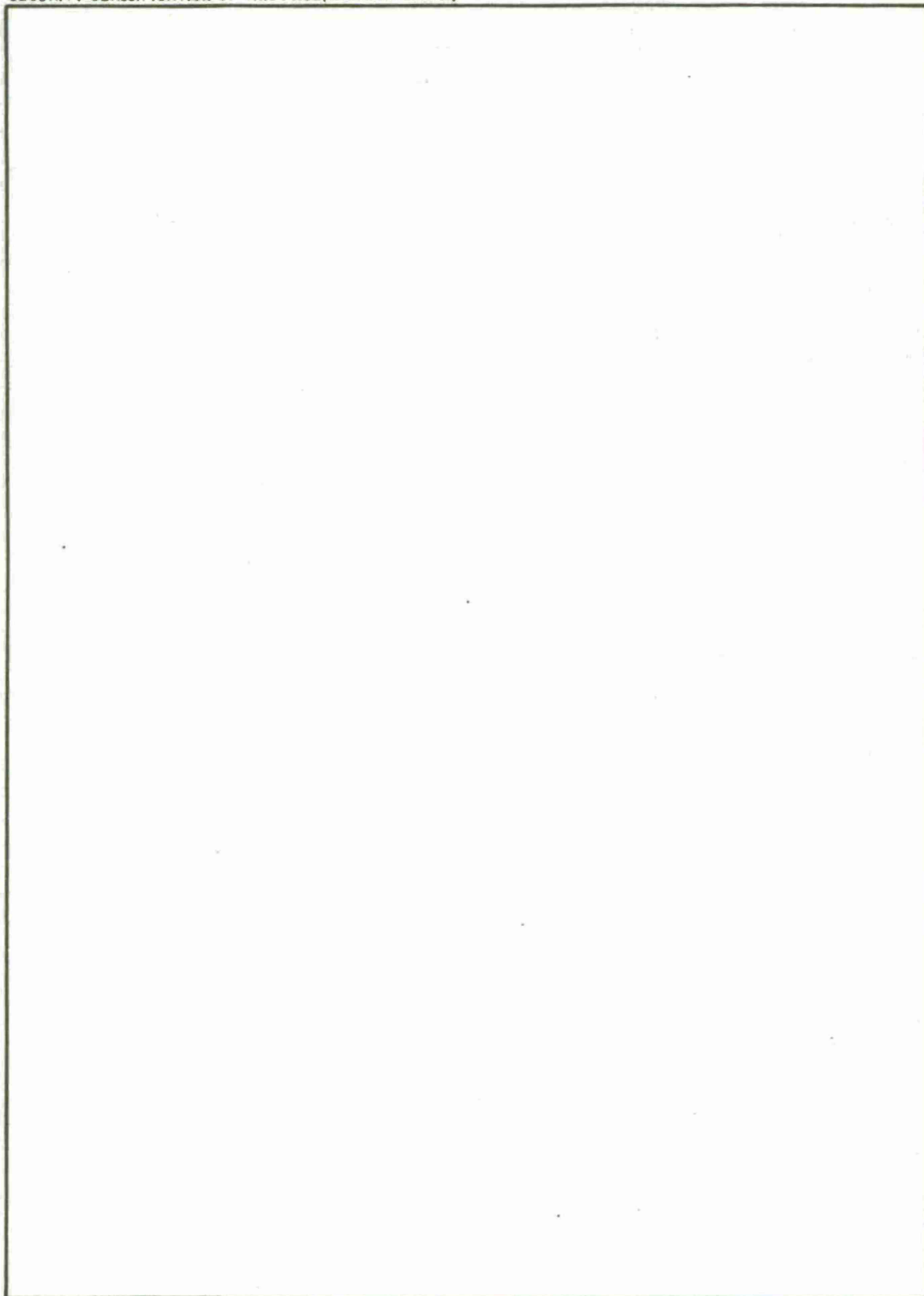
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| 18. SUPPLEMENTARY NOTES This note updates the analysis published in AMSAR/SA/N-30, dated December 1974. | | |
| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Operations Research guided projectile artillery systems risk analysis | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A risk analysis of the schedule and cost associated with the development of the Army 155mm CLGP was performed. The time frame considered for this analysis is "Begin Engineering Development" in July 1975 to "Multi-Year Buy". This analysis is an extension of one performed in Dec 74 and is in preparation for an ASARC/DSARC III. The VERT risk analysis technique was employed to perform the analysis. | | |

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OBJECTIVE

This note updates the Cannon-Launched Guided Projectile (CLGP) Risk Analysis (AMSAR/SA/N-30) which was completed in December 1974. This update includes modifications to the CLGP base-line program, of which one modification is an additional Low Rate Initial Production (LRIP) contractor.

INTRODUCTION

This analysis examines the cost/schedule uncertainties of the major activities and probability of success of the CLGP program from the beginning of Engineering Development (ED) to awarding of the Multi-Year Buy (MYB).

A network technique was used to examine the effects of activities which consume time and cost resources on the CLGP program. Statistical distributions were used to subjectively quantify schedule uncertainties. The cost uncertainties for each activity were considered either constant or time related.

ANALYSIS

Figure 1 presents the network model of the CLGP program. Table 1 presents the estimated cost and time data for each activity and probability of redesign efforts or program termination.

This network differs from the CLGP milestone chart in two respects:

- (1) Following each test (i.e., DT/OT II, DT/OT III, and IPT) the program may enter a redesign phase or terminate. A redesign effort would correct the deficiencies before the scheduled program is continued.
- (2) One or both LRIP contractors may fail to produce acceptable hardware. Failure of one will not terminate the program; however, termination will occur if both fail.

RESULTS

Table 2 presents the expected time and cost with 90% confidence intervals and the probability of occurrence of each outcome. The possible outcomes are as follows:

Awarding of MYB

1. Both Contractors Succeed - The LRIP contractors have proven the producibility of acceptable hardware.
2. Only One Contractor Succeeds - Only one LRIP contractor has proven producibility.

Termination of Program

3. Both Contractors Failed - LRIP hardware produced was not acceptable.

4. ASARC/DSARC III Decision - Program terminated after evaluation of DT/OT II performance data.

The probability of completing the program from ED to MYB with two LRIP contractors is approximately 84%. The expected time and cost is 92 months and \$321M.

The probability of completing the program with only one contractor is approximately 11%. The expected time and cost is 89 months and \$264M.

Program termination can occur by both contractors failing (i.e., LRIP test failures) or an ASARC/DSARC III decision after DT/OT II. The probability of both contractors failing is approximately 0.3% at an expected time of 75 months and an expected cost of \$206M. The probability is approximately 5% that a decision would occur to terminate the program at ASARC/DSARC III at an expected time of 45 months and cost of \$106M.

CONCLUSIONS

The time and cost of the CLGP base line program from the beginning of ED to the awarding of MYB is 83 months and \$313.9M. As indicated by the results, the probability that both LRIP contractors will produce acceptable hardware is approximately 85%; however, the award of MYB is expected to be delayed by 9 months at a cost overrun of \$9M. There is approximately 5% probability of meeting the base line cost and schedule. There is a 95% probability that the program will be completed to the MYB award with at least one acceptable LRIP contractor.

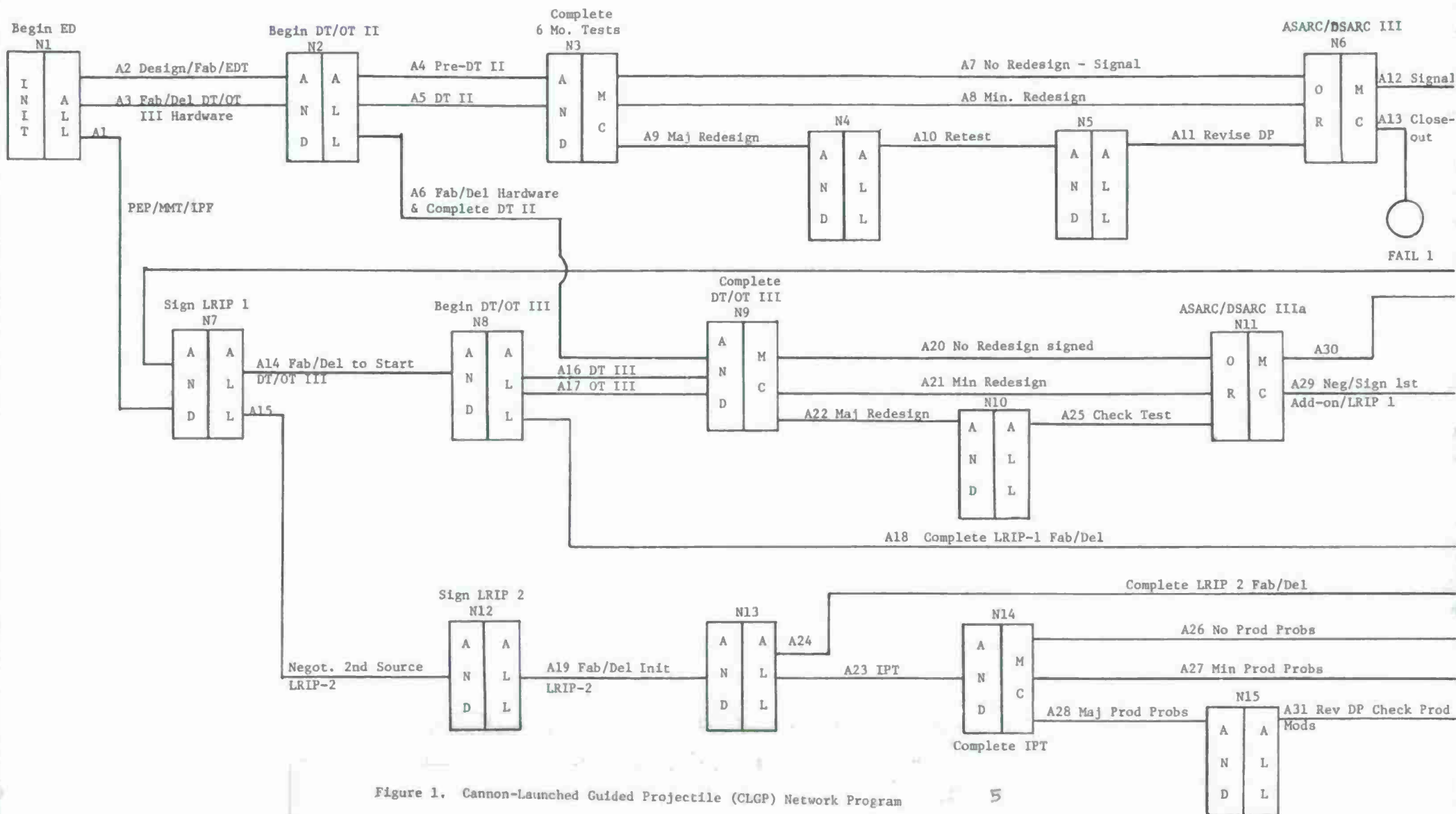


Figure 1. Cannon-Launched Guided Projectile (CLGP) Network Program

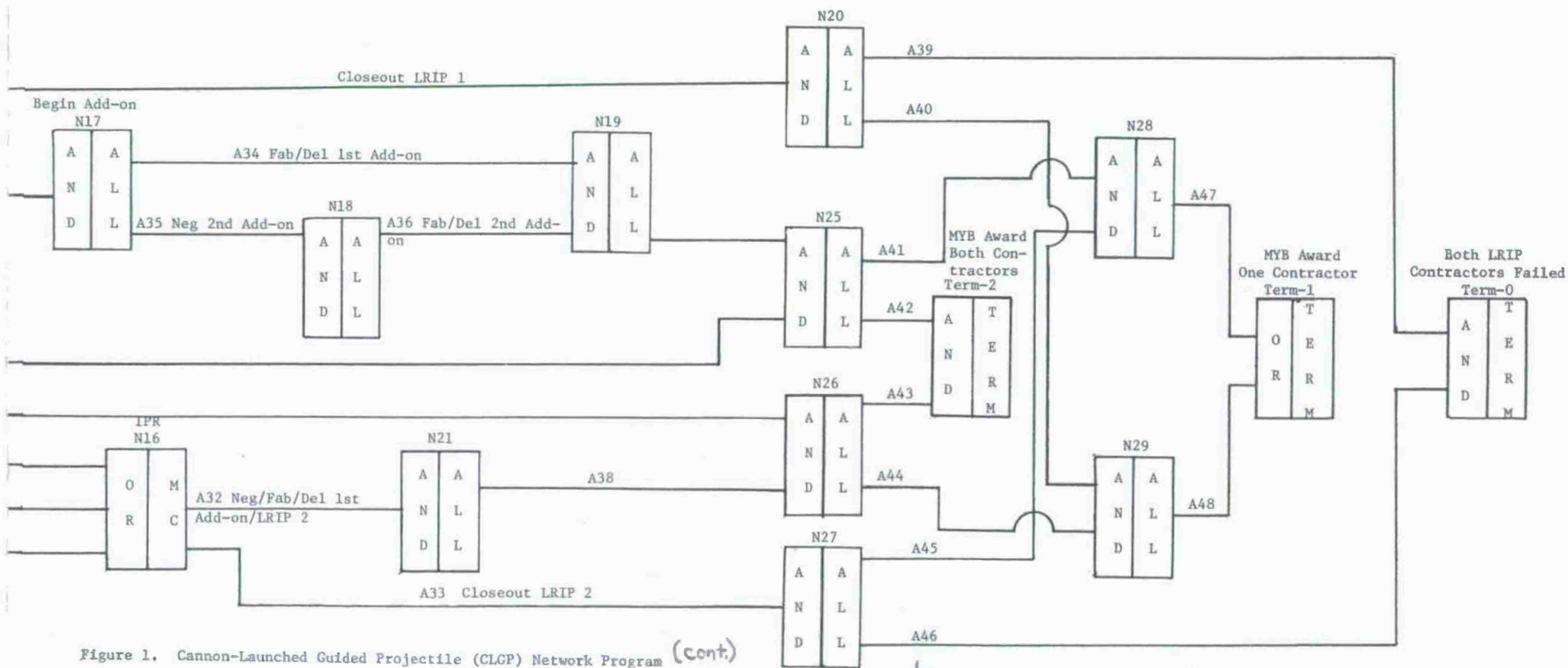


Figure 1. Cannon-Launched Guided Projectile (CLGP) Network Program (cont.)

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TABLE 1. CLGP COST/SCHEDULE DATA

| No. | Description of Activity | Prob. | Time (Mo) (T) | | | Cost Function (\$K) |
|-----|---|-------|---------------|-----|----|---------------------------|
| | | | Min | Max | ML | |
| A1 | Conduct PEP & MMT | | 29 | 33 | 30 | 468.8T+30794 |
| A2 | Design, fabricate, and test ED hardware | | 23 | 30 | 26 | 189T+11802 |
| A3 | Fabricate & deliver DT/OT II Items | | 11 | 17 | 14 | 160T+11998 |
| A4 | Conduct Pre-DT II | | 5 | 8 | 6 | 1928 |
| A5 | Conduct OT II | | 2 | 4 | 3 | 1641 |
| A6 | Fabricate & deliver remaining ED hardware & complete DT II (less A3 & A4) | | 11 | 17 | 15 | 352.5T+15805 |
| A7 | No redesign - signal | 0.40 | | | | |
| A8 | Minimum redesign (No retest required) | 0.45 | 2 | 6 | 4 | 352.5T |
| A9 | Major redesign | 0.15 | 4 | 12 | 6 | 352.5T+11998 |
| A10 | Retest if major redesign | | 3 | 5 | 3 | 1928 |
| A11 | Revise DP and documentation | | 1 | 3 | 2 | |
| A12 | Signal | 0.95 | | | | |
| A13 | Closeout activity if project fails | 0.05 | 6 | 12 | 9 | 330T |
| A14 | Fabricate & deliver enough LRIP-1 item to begin DT/OT III | | 10 | 15 | 12 | 204.2T+3196.8 |
| A15 | Negotiate 2nd source for LRIP-2 | | 6 | 8 | 6 | |
| A16 | Conduct DT III | | 4 | 6 | 5 | 2518 |
| A17 | Conduct OT III | | 2 | 4 | 3 | 300 |
| A18 | Complete fabrication & deliver LRIP-1 | | 18 | 26 | 20 | 194T+60738 |
| A19 | Fabricate & deliver initial LRIP-2 items | | 10 | 16 | 12 | 212T+1995 |
| A20 | No redesign after DT/OT III | 0.65 | | | | |
| A21 | Minimum redesign due to production problems as well as design problems | 0.30 | 2 | 5 | 3 | 212T |

TABLE 1. (Con't)

| No. | Description of Activity | Prob. | Time (Mo) (T) | | | Cost Function (\$K) |
|--------------------|--|-------|---------------|-----|----|---------------------------------------|
| | | | Min | Max | ML | |
| A22 | Major redesign | 0.05 | 5 | 10 | 7 | 212T+1995 |
| A23 | IPT LRIP-2 items and evaluate | | 4 | 7 | 5 | 1750 |
| A24 | Complete fabrication/deliver LRIP-2 | | 9 | 13 | 9 | 212T+34279 |
| A25 | Check test after major redesign of LRIP-1 item | | 1 | 3 | 2 | 1300 |
| A26 | No production problems after IPT | 0.10 | | | | |
| A27 | Minimum production problems after LRIP-2 | 0.60 | 2 | 4 | 3 | 212T |
| A28 | Major production problems after LRIP-2 | 0.30 | 6 | 11 | 9 | 212T+1995 |
| A29 | Negotiate and sign LRIP-1 add-on buy | 0.95 | 4 | 5 | 4 | |
| A30 | Closeout activity if LRIP-1 fails | 0.05 | 6 | 12 | 9 | 330T+6700+3459T (A18) ^a |
| A31 | Check production modification of LRIP-2 | | 1 | 3 | 2 | 1000 |
| A32 | Negotiate/fabricate/deliver 1st add-on buy to LRIP-2 | 0.95 | 18 | 24 | 20 | 180.7T+35933 |
| A33 | Closeout activity if LRIP-2 fails | 0.05 | 6 | 12 | 9 | 330T+8.3+4047T (A24) ^a |
| A34 | Fabrication and deliver 1st add-on buy to LRIP-1 | | 18 | 24 | 20 | 180.7T+35933 |
| A35 | Negotiate and sign 2nd add-on buy to LRIP-1 | | 4 | 5 | 4 | |
| A36 | Fabricate and deliver 2nd add-on buy to LRIP-1 | | 24 | 32 | 27 | 194T+13700 |
| A37 thru A48 | Signal arcs | | | | | |

^aSunk cost of LRIP production (A18 or A24)
at time of contractor close out (A30 or A33).

TABLE 2. CLGP - COST/SCHEDULE ANALYSIS WITH UNCERTAINTIES
(From Engineering Development, July 1975, to Awarding Multi-Year Buy)

| <u>POSSIBLE OUTCOMES</u> | <u>PROBABILITY OF OCCURRENCE</u> | <u>TIME (Mo)</u> | | | | <u>COST (\$M)</u> | |
|---------------------------------|--|-----------------------|-----------------|------------------------|-----------------------|-------------------|------------------------|
| | | <u>5%^a</u> | <u>EXPECTED</u> | <u>95%^b</u> | <u>5%^a</u> | <u>EXPECTED</u> | <u>95%^b</u> |
| <u>Award of MYB</u> | | | | | | | |
| Both Contractors Succeed | .842 | 83 | 92 | 102 | 314 | 321 | 334 |
| Only One Contractor Succeeds | .107 | 80 | 89 | 100 | 244 | 264 | 289 |
| <u>Termination of Program</u> | | | | | | | |
| Both Contractors Failed | .003 | 67 | 75 | 87 | 182 | 206 | 240 |
| ASARC/DSARC III Decision | .048 | 39 | 45 | 56 | 101 | 106 | 119 |

^aThere is a 5% chance that the value will be less than displayed value.

^bThere is a 95% chance that the value will be less than displayed value.

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